Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2015-1041-AC1, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Validation of ash optical depth and layer height retrieved from passive satellite sensors using EARLINET and airborne lidar data: The case of the Eyjafjallajökull eruption" *by* D. Balis et al.

D. Balis et al.

balis@auth.gr

Received and published: 19 April 2016

Response to reviewer #1

We would like to thank the reviewer for his/her fruitful comments that helped to improve our manuscript.

"At various places in the manuscript I would encourage the authors to openly discuss the very small sample sizes and that therefore the presented correlations are rather questionable. Everybody will acknowledge that (perhaps fortunately from the perspective of mankind) the set of available volcanic eruptions is very limited, so discussing

Printer-friendly version

Discussion paper

this in more detail will do the manuscript no harm."

We certainly agree with the reviewer. The small sample issue has been already mentioned in the paper but is further emphasized in all relevant parts of the manuscript, especially in the conclusions.

"p.2 l. 20: replace "Final" by "The last"

The text has been modified accordingly in the revised manucript.

"p.2 l. 22: Potentially it would be advantageous to state that the classification of a "moderate" event is valid in terms of VEI, but not in terms of economic costs."

A relevant comment has been added in the introduction.

"p.4 l.1: Please introduce all abbreviations (SMASH)."

The SMASH abbreviation stands for “Satellite Monitoring of Ash and Sulphur dioxide for the mitigation of aviation Hazards” is explained in Page 4 and SACS-2 in page 3. In the revised manuscript will also be explained in the abstract.

"p. 4 l.14: Is it possible to give either a citation for the AAI or to shortly describe the fundamental principles of its derivation for those readers who are not familiar with this method?"

In the revised paper, two references have been included in the text directly after mentioning AAI. The revised text is: “The volcanic ash retrieval algorithm includes an estimation of the optical depth of an ash layer based on the Absorbing Aerosol Index (AAI) (Herman et al., 1997; Torres et al., 1998) as well as an estimation of the effective ash layer height”

"p. 4 l.17: In fact it is the absorbing AOD which is most dominant in AAI. A high AOD of a non-absorbing aerosol will not at all produce a high AAI. Consequently all AAI results are very sensitive to SSA."

We agree with the reviewer that the absorbing AOD is most dominant in AAI. The AOD from scattering aerosols would lower the AAI values. AAI results are very sensitive to SSA. In the text, we mentioned that AAI is sensitive to aerosol types, AOT .... The sensitivity of AAI to SSA is included implicitly in the sensitivity of AAI to the aerosol type.

"p. 4 l. 27: What are the parameters of the log-normal distributions?"

The parameters of the bi-mode log-normal size distribution for aerosols are effective radius, effective variance for fine and coarse modes, and the weight of the two modes. In our calculations, we used effective radius of 0.052 μm and effective variance of 1.697 μm for the fine mode, effective radius of 0.67 μm and effective variance of 1.806 μm for the coarse mode. The weight of the fine mode is 0.99565. This information is now included in the revised manuscript.

"p. 4 l. 30: I would suggest to split the section 2.1.2 into two subsections, one for the UOXF algorithm and one for the ULB one."

In the revised version we split section 2.1.2 in two subsections as suggested by the reviewer.

"p. 5 l. 2: What is the spectral resolution of the Eyja refractive indices? Is there already a publication on these?"

The spectral resolution of these indices is 1 cm-1. As far as we are aware of, these indices have not been published yet.

"p. 5 l. 3: The Pollack database includes pre-tabulated refractive indices as well as oscillator parameters for modelling these. The pre-tabulated indices have rather coarse spectral resolution (given the resolution of the IASI instrument). Which of the two sets has been used? And if it is the pre-tabulated ones, how has the interpolation to the required IASI channels been done?"

The pre-tabulated values have been used, interpolated using the Piecewise Cubic Her-

mite Interpolating Polynomial, which is shape preserving.

"p. 5 l. 8: What is the mode radius of the log-normal distributions?"

For the ULB the mode radius was retrieved along with the optical depth (see Moxnes et al, 2014). Mode radius is retrieved together with ash optical depth, plume altitude and surface temperature for the Oxford algorithm.

"p. 5 l. 20: Which meteorological input has been used for the RTTOV calculations? Moreover, to my understanding RTTOV is a radiative transfer model, which provides radiance or brightness temperatures or parameters like that which are simulated from given inputs including meteorology, AOD, PSD and such things. So these parameters are input to RTTOV and not provided by the model. Or is there something like an "inverse mode" in RTTOV to obtain these parameters from the radiation field? Then RTTOV would be a suitable retrieval method and no further work would be required."

ECMWF data are used as input to RTTOV. The Oxford iterative algorithm is a full optimal estimation retrieval scheme that calls iteratively the forward model. The forward model is based on RTTOV. RTTOV output for a clean atmosphere (containing gas but not cloud or aerosol/ash) is combined with an ash layer using the same scheme as for the Oxford-RAL Retrieval of Aerosol and Cloud (ORAC) algorithm (Thomas et al., 2009a, 2009b). In the text we have substituted the sentence: “RTTOV then provides probable values of AOD, effective radius and plume altitude [Ventress et al. 2015].” with: “The iterative retrieval scheme then provides probable values of AOD, effective radius and plume altitude [Ventress et al. 2016].”

"p. 7 l. 9: Please introduce all abbreviations (PCASP and CAS)."

PCASP stands for Passive Cavity Aerosol Spectrometer Probe and CAS stands for Cloud and Aerosol Spectrometer. Both have been introduced in the text.

"p. 8 l. 13: Would it be possible to provide the 532nm refractive index for the Eyjafjalla ash? Or is there already a publication on this?"

The refractive index used for Eyjafjalla ash is 1.572 +i 7.5e-06 at 530nm. This value is now mentioned in text of the revised manuscript.

"p. 9 l. 19-20: When the authors say "dust" and "Volz", do they really mean two different algorithms, or do they rather mean two different complex refractive indices used as input for the same algorithm? Please clarify."

We mean two different complex refractive indices used as input for the same algorithm. This is clarified in the revised manuscript.

"p. 9 l. 29: Give the FOV size of the IASI Instrument, not only thin clouds, but also partially cloudy observation could have an effect."

This is certainly the case for the ULB algorithm. For that reason, there is a strict quality check at the end of the algorithm, based on the retrieved parameters and the fit residual, which removes most of the cloudy observations. For the Oxford algorithm the spectral variability due to clouds is contained within the covariance matrix and, hence, if the cloud is below the ash plume, it should not present a problem. More details can be found in Ventress et al. 2016.

"p. 10 l. 21: To which number does the number of coincidences decrease? Is the calculation of a correlation coefficient still useful then?"

The number of coincidences with EARLINET stations are shown in the legends of Figure 2. For IASI-UOXF are around 18-20 and for IASI ULB are 13. In any case the sample is small for both data sets.

"p. 15 l. 11: Please replace "excellent" by "very good"."

The text has been modified accordingly

"p. 15. l. 17: The same - given the small sample size I would be rather shy about using the term "excellent"."

The text has been modified accordingly.

"Table II and Table III: Is "Amount of data in days" equivalent to "coincidences"? If not, please provide also the latter number."

No, it is not equivalent. With “amount of data” it is meant the number of days for which satellite retrievals were available. We introduced an additional column with the number of coincidences in the relevant tables. The number of coincidences are already shown in the legends of the plots.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2015-1041, 2016.

Printer-friendly version

Discussion paper